Ill., the river was closed by a gorge 4 miles below that place on the 4th; gorge broken on the 11th. At Alton, Ill., floating ice was reported on the 4th to 6th, 10th, and 11th.

Missouri River.—Floating ice in the river at Leavenworth, Kans., on the 2d to 7th, 9th to 12th, 19th to 21st, and 25th to 28th. Ice in the river at Kansas City, Mo., 2d to 13th, 17th to 22d, 27th, and 28th. Running ice at Saint Joseph, Mo., 1st, 2d, 7th to 11th, 17th to 22d, 25th, 26th, and 27th; ice blocked at the draw in the bridge on the 28th. At Hermann, Mo., floating ice on the 4th to 6th and 16th.

Light drift ice was reported in the harbor at Portland, Me., on the 8th. Lake Champlain was clear of ice at Burlington, Vt., on the 1st, but was partially closed the latter part of the month. Navigation was obstructed by slush ice at Grand Haven, Mich., on the 3d to 6th, 9th and 10th.

Heights of rivers above low-water mark, February, 1891 (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water. Date.	Highest water. Height.	Lowest water. Date.	Lowest water. Height.	Monthly range.
Red River.						
Shreveport, La	29.9	11, 13	25.2	28	21.5	3.7
Arkansas River.						
Fort Smith, Ark	22.0	25	11.9	20	3.3	8.6
Little Rock, Ark	23.0	27	14.5	20	8.1	6.4
Missouri River.						
Fort Buford, N. Dak*	.....	.....	.....	.....	.....	.....

Heights of rivers—Continued.

Stations.	Danger-point on gauge.	Highest water. Date.	Highest water. Height.	Lowest water. Date.	Lowest water. Height.	Monthly range.
Missouri River—Continued.						
Kansas City, Mo	21.0	23	7.5	5	2.8	4.7
Mississippi River.						
Saint Paul, Minn*	14.0	.....	.....	.....	.....	.....
La Crosse, Wis*	13.0	.....	.....	.....	.....	.....
Dubuque, Iowa*	16.0	.....	.....	.....	.....	.....
Davenport, Iowa	15.0	21	5.2	1	1.1	4.1
Keokuk, Iowa	14.0	8	4.0	4	— 0.2	4.2
Saint Louis, Mo	30.0	26, 27	11.5	9, 11	3.4	8.1
Cairo, Ill	40.0	28	45.5	1	27.9	17.6
Memphis, Tenn	33.0	26, 27, 28	33.0	1	19.0	14.0
Vicksburg, Miss	41.0	28	43.2	2	28.2	15.0
New Orleans, La	13.0	26	14.9	4, 5, 6, 7	11.0	3.9
Ohio River.						
Pittsburgh, Pa	22.0	18	31.3	7, 15	9.2	22.1
Parkersburgh, W. Va	38.0	21	44.6	16	16.0	28.6
Cincinnati, Ohio	45.0	25	57.4	1	33.6	23.8
Louisville, Ky	24.0	26	32.3	1	12.3	20.0
Cumberland River.						
Nashville, Tenn	40.0	15	41.2	23	20.4	20.8
Tennessee River.						
Chattanooga, Tenn	33.0	14	37.5	1	9.8	27.7
Knoxville, Tenn	29.0	11	21.9	1.8	5.2	16.7
Monongahela River.						
Pittsburgh, Pa	29.0	18	31.3	7, 15	9.2	22.1
Savannah River.						
Augusta, Ga	32.0	9	27.2	16	13.1	14.1
Willamette River.						
Portland, Oregon	15.0	15	5.7	5	1.3	4.4

*Frozen.

MISCELLANEOUS PHENOMENA.

SUN SPOTS.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new—Groups.	Number of new—Spots.	Disappeared by solar rotation.—Groups.	Disappeared by solar rotation.—Spots.	Reappeared by solar rotation.—Groups.	Reappeared by solar rotation.—Spots.	Total number visible.—Groups.	Total number visible.—Spots.	Faculæ.	Remarks.
Feb., 1891.										
1, 2 p. m.	0	0	1	2	0	0	2	22	0	Definition fair; spots small.
2, 9 a. m.	1	1	0	0	0	0	3	10	1	Definition good; spots small.
4, 9 a. m.	0	0	1	6?	0	0	0	0	1	Definition poor: spots small.
5, 9 a. m.	1	1	0	0	0	0	1	1	1	Definition poor; spots small.
6, 9 a. m.	0	0	0	0	0	0	1	2	2	Definition fair; spots small.
8, 10 a. m.	1	1	0	0	0	0	2	2	1	Definition good; spots small.
10, 10 a. m.	1	30	0	0	0	0	2	33	0	Definition fair.
11, 11 a. m.	1	33	0	0	0	0	3	65	0	Definition fair.
13, 3 p. m.	1	3	0	0	1	....	3	26	1	Definition good; 1 large spot.
14, 9 a. m.	1	3	0	0	0	0	4	32	1	Definition fair; 1 large spot.
15, 9 a. m.	0	32	0	0	0	0	4	54	2	Definition good; 1 large spot.
18, 9 a. m.	2	14?	0	0	0	0	5	36	4	Definition fair.
19, 11 a. m.	0	0	0	0	0	0	4	14	1	Definition bad.
22, 9 a. m.	2	30	0	0	0	0	6	55	3	Definition good; immense faculæ.
23, 4 p. m.	0	0	0	0	0	0	4	45	1	Definition good.
24, 10 a. m.	0	0	0	0	0	0	3	28	1	Definition fair.
25, 10 a. m.	0	27	0	0	0	0	2	46	3	Definition fair.
27, 9 a. m.	1	2	1	0	0	0	2	25	1	Definition good.
28, 9 a. m.	0	0	0	0	0	0	1	18	1	Definition good; spots small.

Mr. D. E. Hadden, Alta, Iowa: 1st, 2 groups, 3 spots; groups n. latitude. 2d, 1 group, 1 spot. 3d, large group; faculæ near nw. limb. 5th, 1 group, 1 spot, and faculæ; spots small sw. 6th, faculæ. 7th, faculæ on e., se., and w. limbs. 10th, 1 group, 10 spots, and faculæ; group n. latitude e. of meridian. 11th, 2 groups; aurora preceding evening; 15 spots, and faculæ; new group s. latitude; 4 large spots in group n. latitude; faculæ on w. limb. 2 groups, 12 spots; brilliant faculæ by rotation on se. limb. 13th, 3 groups, 12 spots, and faculæ; new group se. 14th, 3 groups, 9 spots, and faculæ; groups se., nw., and sw. 15th, 2 groups; large faculæ by rotation on se. limb. 17th, 1 group about 2 days in on ne. limb; clouds; could not count spots; suspected aurora in the evening. 18th, 2 groups, 12 spots, and faculæ; penumbra around spots in large group; other group, small, e. of larger group. 20th, 3 groups, 18 spots; large areas faculæ by rotation on ne. limb. 21st, 3 groups, 12 spots, and faculæ; large group unchanged; penumbra around spots. 23d, 3 groups, 9 spots; large faculæ e., and near w. limb. 26th, 2 groups, 6 or 8 spots; faculæ on nw. and w. limbs; groups near meridian n. latitude. 28th, 1 group, 2 spots; extensive groups faculæ w.; spots in faculæ. Cloudy 8th, 16th, 19th, 24th, 25th, and 27th.

Mr. John W. James, Riley, Ill: none seen till 11th, then 2 groups on sun's meridian in n. latitude. 12th, 2 new groups 1 day past meridian in s. latitude. 13th, 1 group gone. 14th, 2 new spots in s. latitude w. of meridian; prominent faculæ on se. edge of disc, followed next day by a large faint spot. 18th, 2 new groups in n. latitude; these were on sun's meridian 20th, and the largest spot in them disappeared by solar rotation 26th. 25th, 1 new group on sun's meridian in n. latitude. 27th, 28th, no spots seen.

Mr. H. D. Gowey, North Lewisburgh, Ohio: sun spots were observed on the 10th, 11th, 13th, 14th, and 22d.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were widely observed on the 9th, when they were noted in Ind., Iowa, Minn., S. Dak., and Wis.; on the 11th, when they were noted in Ill., S. Dak., Wis., Mich., Mass., N. H., and Me.; on the 12th, when they were noted in Me., Mass., Mich., and Mont.; and on the 14th, when they were noted in Ill., Mich., Mass., N. H., and Me. On the 11th, at 10.40 p. m., a brilliant aurora was observed at Portland, Me. It appeared as a whitish glow resting upon a dark segment, and reached altitude about 15°, and extended from 160° to 220° of azimuth.

The display reached its greatest brilliancy about 11.20 p. m., when streamers reached altitude about 45°. After that hour the streamers slowly drifted from the centre towards either side. The display continued until after midnight. On the 11th an aurora of a pale white color, accompanied at times by "merry dancers," was visible at Detroit, Mich., from 9.20 p. m. until nearly midnight. The display was first observed in the west and extended to altitude about 25°. On the 11th an auroral arch, extending from azimuth 161° to 224° and reaching altitude 20°, was observed at Fort Sully, S. Dak., from 10 p. m. to midnight. There were 2 arches, and beneath the inner arch was a dark segment, the northeast portion or right half of which was partly overspread with a bright light. Shortly before and after the disappearance of the aurora bright cloudy patches were seen above the eastern and western extremities of the arch. On the 12th an aurora consisting of a bright yellow arch above a dark segment was observed at Sault de Ste. Marie, Mich., from 10.30 to 11.45 p. m. The display reached altitude 20°, and extended from nw. to ne. Numerous slender beams were observed, some of which reached altitude 25°. The display attained its greatest brilliancy about 11.20 p. m.

Auroras were reported as follows: 7th, Kimball, S. Dak. 8th, Cambridge, Mass. 9th, Seymour, Ind.; Alta, Cresco, and Williams, Iowa; Red Wing, Montevideo, Morris, Sheldon, and Pine River, Minn.; Parkston, Webster, and Wolsey, S. Dak.; Hayward and Medford, Wis. 11th, Riley, Ill.; Eastport and Portland, Me.; Fall River, Royalston, Cambridge, Newburyport, and Blue Hill Obs., Mass.; Detroit, Caldwell, and Gulliver Lake, Mich.; Choteau, Mont.; Hanover, N. H.; Eagle's Mere, Pa.; Wolsey, S. Dak.; Peshtigo, Wis. 12th, Portland, Me.; Blue Hill Obs., Mass.; Sault de Ste. Marie, Mich.; Glendive, Mont. 13th, Eastport and Orono, Me.; Hanover, N. H. 14th, Sandwich, Ill.; Eastport, Me.; Cambridge, Mass.; Caldwell, Mich.; Hanover, N. H. 15th, Nashua, N. H. 18th, Bellevue, Ohio. 20th, Plymouth, N. H.; Bellevue, Ohio; Hanover, N. H.

THUNDER-STORMS.

Thunder-storms were reported as follows: east of the Rocky Mountains thunder-storms were reported in the greatest number of states, 15, on the 25th; in 14 on the 8th; in 12 on the 20th; in 11 on the 9th and 19th; in 10 on the 24th and 28th; in 9 on the 2d; in 8 on the 3d and 21st; in 6 on the 1st and 12th; in 5 on the 7th; in 4 on the 17th; in 3 on the 6th and 26th; in 2 on the 10th, 11th, 13th, 18th, and 23d; and in 1 on the 5th, 14th to 16th, and 27th. The 4th and 22d, were the only dates on which no thunder-storms were reported.

East of the Rocky Mountains thunder-storms were reported on the greatest number of dates, 12, in N. C.; on 11 in Miss.; on 10 in La.; on 9 in Ala.; on 8 in Ark.; on 7 in Ill, Ind., and Mo.; on 6 in Fla., Ky., Mass., Ohio, S. C., and Tenn.; on 5 in Ga. and Tex.; on 4 in Wis.; on 3 in Kans., Mich., and Pa.; on 2 in Conn., Iowa, and N. J.; and on 1 in Ind. T., Md., N. H., N. Y., Okla. T., R. I., Vt., and Va. West of the Rocky Mountains thunder-storms were reported as follows: Ariz., 23d and 26th; Cal., 12th, 16th, 22d to 24th, and 28th; Colo., 23d; Oregon, 12th and 14th; Utah, 23d; Wash., 19th, 20th, and 22d. In Del., D. C., Idaho, Me., Minn., Mont., Nebr., Nev., N. Mex., S. Dak., N. Dak., and Wyo., no thunder-storms were reported.

VERIFICATIONS.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

FORECASTS FOR 24 HOURS IN ADVANCE.

The forecasts for districts east of the Rocky Mountains for February, 1891, were made by 1st Lieutenant W. A. Glassford, Signal Corps, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant John P. Finley, 19th Infantry.

Percentages of forecasts verified, February, 1891.

States.		States.	
Maine	90.6	Kentucky	83.9
New Hampshire	94.9	Ohio	90.5
Vermont	92.1	West Virginia	90.7
Massachusetts	92.6	Indiana	89.9
Rhode Island	97.4	Illinois	90.9
Connecticut	95.0	Lower Michigan	90.4
Eastern New York	93.4	Upper Michigan	82.2
Western New York	89.3	Wisconsin	86.4
Eastern Pennsylvania	90.6	Minnesota	83.9
Western Pennsylvania	92.4	Iowa	83.8
New Jersey	89.6	Kansas	80.6
Delaware	92.3	Nebraska	78.9
Maryland	89.8	Missouri	87.7
District of Columbia	92.4	Colorado	77.6
Virginia	90.1	North Dakota	86.4
North Carolina	86.5	South Dakota	79.1
South Carolina	84.5	Southern California*	83.4
Georgia	81.7	Northern California*	92.3
Eastern Florida	87.3	Oregon*	85.7
Western Florida	86.8	Washington*	82.3
Alabama	87.6	*By elements:* Weather	90.4
Mississippi	85.1	Temperature†	84.2
Louisiana	86.6		
Texas	83.2	Monthly percentage of weather and temperature combined‡	87.9
Arkansas	88.3		
Tennessee	88.5		

*In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. †The forecasts of temperature in districts east of the Rocky Mountains for February, 1891, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

FORECASTS FOR 48 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for 48 and 72 hours, covering the 2d and 3d days in advance. These are optional with the forecast official, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 98; temperature, 75. Percentages of verifications: weather, 51.6; temperature, 88.3; weather and temperature combined, 64.0.

WIND SIGNALS FOR FEBRUARY, 1891.

Statement showing percentages of justifications of wind signals for the month of February, 1891:

Wind signals.—(Ordered by Lieutenant W. A. Glassford). Total number of signals ordered, 116; justified as to velocity, wholly, 76, partly, 6; justified as to direction, 110. Of the signals ordered 88 were cautionary, of which 57 were wholly and 3 partly justified; and 28 were storm signals, of which 19 were wholly and 3 partly justified. 25 signals were ordered for easterly winds, of which 23 were justified, and 91 were ordered for westerly winds, of which 87 were justified. Percentage of justifications, 69.7.

COLD-WAVE SIGNALS AND TEMPERATURE-FALL WARNINGS.

[Ordered by Assistant Professor T. Russell.]

Number of cold-wave signals ordered, 378; justified, 264. Percentage of justifications, 69.8. Number of temperature-fall warnings, 103. Percentage of justifications, 48.5. Percentage of justifications of cold-wave signals and temperature-fall warnings combined, 67.3.

Percentages of verifications of weather and temperature signals reported by directors of the various State Weather Services for February, 1891.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois	86	89	New Jersey	88	85
Indiana	87	87	New York	85	86
Iowa	87	89	North and South Dakota	84	88
Michigan	86	89	Ohio	92	91
Minnesota	85	77	Pennsylvania	88	88
Nebraska	82	82	South Carolina	90	87